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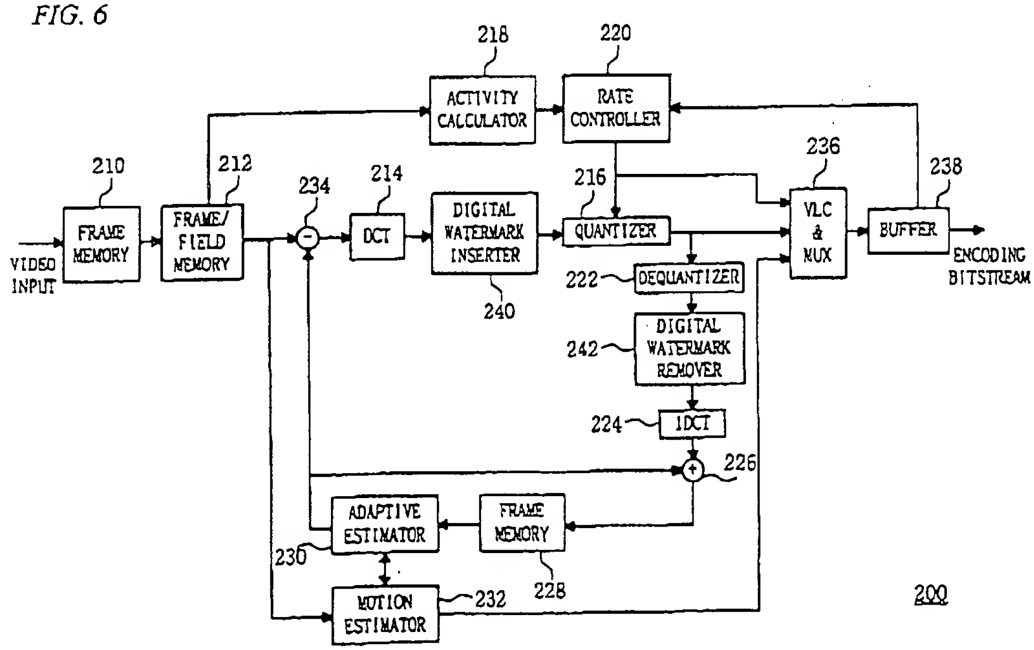
MPEG2 encoding with watermark

(57) An MPEG2 moving picture encoding/decoding system provides digital copy protection of digital moving picture data. The MPEG2 moving picture encoder discrete cosine transforms a video input 214 and uses a digital watermark inserter 240 to embed digital watermark information on a frequency domain of the discrete cosine transformed video input signal. The MPEG2 moving picture decoder removes the embedded visual watermark information to locally decode the encoded video signal.

FIG. 6



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AN MPEG2 MOVING PICTURE ENCODING/DECODING SYSTEM

The present invention can be used for a Moving Picture Experts Group moving picture compression/ decompression application of motion prediction/ compensation based on a discrete cosine transform and minimizes degradation of image quality.

This invention relates to a digital copy protection application of moving picture data which is seldom removed intentionally or unintentionally by a user except an author, and more particularly, relates to an MPEG2 moving picture encoder/decoder.

The MPEG2 standard is a compression/decompression standard for video applications, and exploits temporal redundancy for motion compensated interpolated and predicted encoding. That is, the assumption is made that "locally" the current picture can be modeled as a translation of the picture at a previous and/or future time. "Locally" means that the amplitude and direction of the displacement are not the same everywhere in the picture.

The MPEG2 standard specifies predicted and interpolated interframe encoding and spatial domain intraframe encoding. It has block based motion compensation for the reduction of temporal redundancy, and block based Discrete Cosine Transform based on compression for the reduction of spatial redundancy.

The information relative to motion is based on a 16×16 array of pixels and is transmitted with the spatial information. Motion information is compressed with variable length codes, such as Huffman codes.

Recently, audio/video information expressed as digital information is becoming more widely used and a method utilizing digital products also has been increasing accordingly as digitalization of the A/V application and popularity of the internet have been increasing rapidly.

Specifically anybody who is able to use a PC can copy/edit digital products easily and accordingly a social issue of illegal copying has been raised. A watermark technique has become prominent as a solution to prevent this problem.

There are two exemplary methods for providing copy protection of digital A/V data to prevent illegal copying. The first method is encryption, i.e., a copy protection method by scrambling the digital information. The second method is a digital watermark method with the purpose of preventing the illegal use of digital information.

The first method is a technique for prevention of illegal copying of digital A/V data, by providing descramble information and password information capable of accessing and running the A/V product only in the case that the A/V product is bought legally.

The second method is a technique which utilizes self-restraint by a user to not produce an illegal copy of the A/V product by embedding ID information or a logo in a state of noise into A/V contents data of the A/V product for the purpose of forbidding the illegal or commercial use of digital information. The watermark technique is used on the original image and is invisible to a person who would copy it, but the author can prove that the copied image is his by virtue of an arbitrary reverse processing.

For example, in a case where a counterfeiter forges money using a colour copier, a vignette on the original bill turns clear by copying the bill, and consequently it makes it virtually impossible to copy bank note. This is called a visible watermark.

Also, in the case where a spy writes a message onto paper with salt water, other people will think this is an ordinary blank piece of paper, but this paper is a medium having an important information for the spy – because he can see the message anytime he wants to by heating the paper. In this case, we call it an invisible watermark.

At present, the watermark technique is used for digital still images or audio, i.e., putting the message distinguishable from the original image into the image. Therefore, in the case that an author's own image circulates illegally, the image can be proved to be that of author by performing an arbitrary reverse processing.

Thus, techniques for preventing the illegal copying of digital product are increasingly being studied these days.

Figures 1 and 2 illustrate a conventional MPEG2 moving picture encoder and decoder respectively. Figure 3 illustrates a structure of a video picture used in the MPEG2 moving picture encoder/decoder and, Figure 4 illustrates three types of pictures and their relationship under the MPEG2 standard. We will explain the conventional MPEG2 moving picture encoder and decoder by referring to these figures.

One picture can be divided into uniformly sized regular square areas and each area is transformed.

Therefore, the image is divided into image ingredients of different frequencies from an average value (DC value) to an image ingredient value of an extremely high frequency. This division process is called an orthogonal transformation and the orthogonal transformation is a discrete cosine transform (DCT).

Orthogonal transformations, because they have a frequency domain interpretation, are filter bank oriented. The discrete cosine transform is also localized. That is, an encoding process illustrates samples on an 8×8 spatial window which is sufficient to compute 64 transform coefficients or sub-bands.

Another advantage of the discrete cosine transform is that fast encoding and decoding algorithms are available. Additionally, the sub-band decomposition of the discrete cosine transform is sufficiently well behaved to allow effective use of psychovisual criteria.

After the discrete cosine transform, many of the higher frequency coefficients are zero. These coefficients are organized into a zigzag, as illustrated in Figure 5, and converted into run-amplitude (run-level) pairs. Each pair indicates the number of zero coefficients. This is coded in a variable length code.

Discrete cosine transform encoding is carried out in the three stages as illustrated in Figure 5. The first stage is the computation of the discrete cosine transform coefficients. The second stage is the quantization of the coefficients. The third stage is the conversion of the quantized transformation coefficients into run-amplitude pairs after reorganization of the data into a zigzag scanning order.

Quantization can be viewed as a shift to the right by several bits. Quantization enables a very high degree of compression, and a high output bit rate, and retains high picture quality. Quantization can be adaptive with I picture having fine quantization to avoid "blockiness" in the reconstructed image. This is important because I pictures contain energy at all frequencies. By way of contrast, P and B pictures contain predominately high frequency energy and can be coded at a coarser quantization.

One challenge facing decoder designers is the accommodation of a single decoder system to a variety of display output formats, while complying fully with luminance/chrominance relationships and the MPEG2 standard. The displayed output of the decoder chip must conform to Consultative Committee International Radio (CCIR) recommendation 601. This specifies the number of luminance and chrominance pixels in a single active line, and also how the chrominance pixels are subsampled relative to the luminance signals.

The format defined as 4: 2: 2 is supported in most cases in industry. This defines 720 active luminance signals, and 360 colour differentiated signals, where each line of luminance signals has a corresponding line of chrominance signals. CCIR recommendation 656 goes on to define the number of active lines for National Television System Committee (NTSC) and Phase Alternation by Line (PAL) environments as 480 and 576, respectively. The contents as noted above are disclosed in U. S. Pat. No. 5,668,599.

An MPEG2 moving picture encoder 100 performs an encoding method by utilizing the cooperation of an

intracoding method on the spatial domain and an intercoding method on the temporal domain. The MPEG2 moving picture encoder 100 performs the intracoding method on the spatial domain by compressing the original image into a variable length coding of a Huffman code through a DCT 114 and a quantizer 116 and transmits the variable length code.

The MPEG2 moving picture encoder 100 performs the intercoding method on the temporal domain by decompressing the I picture compressed on the spatial domain through a dequantizer 122 and an Inverse Discrete Cosine Transform (IDCT), and predicts by comparing the compressed I picture with the image being inputting at present through a frame memory 128 and an adaptation estimator 130, and then encodes a difference signal with the original signal by compensating motion, i.e., spatial-shifting the image being input at present as much as the predicted motion.

In the case that a method predicting motion is forward prediction, we call it a P picture and in case that a method predicting motion contains all of forward and backward predictions, we call it a B picture. Accordingly motion prediction and compensation of P and B images are affected by the picture accuracy coded as an I picture. So, in the decoding process decoding the encoded image, first, the I picture must be decoded exactly so that the P and B images, to which the difference signals are transmitted, can be decoded accurately.

But even through the use of the copy preventing technique by encryption and scrambling as noted above, it is possible to easily copy data when duplication and key data are known. And also the watermark technique for moving picture data has some problems which can reduce

encoding efficiency by embedding ID information and a logo in the form of noise.

The picture structure of an MPEG2 moving picture encoding method, as illustrated in Figure 4, includes intraframe (I picture) reducing spatial redundancy information of image information, a predicted frame (P picture) reducing interrelation between frames through forward prediction, and an interpolated frame (B picture) reducing between frames through bidirection prediction.

Therefore, in decoding of the image signal, only in the case where the decoded previous I picture exists, can the P picture be decoded perfectly through motion compensation, and only in the case where the decoded I and P pictures are used in B picture prediction in the encoding process, can the B picture be decoded through motion decoding.

Up to now, digital watermark information discrete-cosine-transformed in the form of noise is embedded into an original image and an I picture codes this digital watermark information.

And it is used as a reference in the case of predicting motion of the P and B pictures according to encoding locally the I picture. Consequently there is a problem of an error while estimating motion of the P and B pictures by the mixed watermark information.

Because the watermark technique for still images, which has started to be studied recently as noted above, includes watermark data on the spatial domain, the watermark technique is not suitable for MPEG encoding method compressing data by removing redundancy information

in accordance with using interrelation of data on the spatial domain and the temporal domain.

That is, in case the image quality of the image that contains the watermark deteriorates conspicuously in comparison with the image quality where the watermark information is not contained, the meaning can be lost because the image can deteriorate even though the original object contains watermark information.

Thus, the image containing the watermark has to appear very similar to image which does not contain the watermark information.

It as an aim of embodiments of the present invention to solve or reduce the above-noted problems and can be used by MPEG moving picture compression/decompression applications of motion prediction/compensation based on the discrete cosine transform.

Accordingly, it is an aim of embodiments of the invention to provide a digital copy protection apparatus of moving picture data that makes it difficult to get rid of watermark information by a user except an author, in accordance with maximizing degradation of pixel.

A second aim of embodiments of the present invention is to provide an MPEG2 moving picture encoder and a third object of the present invention provides an MPEG2 moving picture decoder.

Also, a fourth aim is to provide an MPEG2 moving picture encoding/decoding system with the encoder and the decoder.

Additional objects and advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

According to a first aspect of the invention, there is provided an MPEG2 moving picture encoder to encode a video signal with digital watermark information and including a frame memory, a frame/field memory, an activity calculator, a rate controller, a Discrete Cosine Transform (DCT) unit, a quantizer, a dequantizer, an Inverse Discrete Cosine Transform (IDCT) unit, an adaptation estimator, a motion estimator, a variable length coder and multiplexer (VLC & a MUX) and a buffer, the MPEG2 moving picture encoder comprising: a Discrete Cosine Transform (DCT) unit to discrete-cosine-transform the digital watermark information; a digital watermark inserter installed between said DCT and said VLC & MUX, to embed the digital watermark information discrete-cosine-transformed by said DCT on a frequency domain of the video signal; and a digital watermark remover, installed between said dequantizer and said IDCT, to remove digital watermark information on a spatial domain of the DCT embedded, so as to prevent an error during estimating motion on a temporal domain for P and B pictures of the video signal.

Said digital watermark inserter is preferably located between said DCT and quantizer.

Said digital watermark inserter is preferably located between said quantizer and said VLC & MUX.

Said DCT unit may use an 8x8 DCT to embed the watermark information on the frequency domain of the video signal.

Said IDCT preferably prevents an error of a temporary domain coding by watermark.

According to a second aspect of the invention, there is provided an MPEG2 moving picture decoder to decode an encoded bit stream comprising: a first buffer to receive and save the encoded bit stream; a variable length decoder and demultiplexer (VLD & a DEMUX) to receive the encoded bit stream from said first buffer and to variable-length-decode the encoded bit stream; a dequantizer to dequantize the variable length decoded signal from said VLD & DEMUX; a digital watermark remover to remove a digital watermark embedded in the dequantized signal to locally decode by reading watermark information and information from said dequantizer, to generate a dequantized signal without the digital watermark; a first Inverse Discrete Cosine Transform (IDCT) unit to inverse-discrete-cosine-transform the dequantized signal without the digital watermark from said watermark remover, to generate a first IDCT signal; a digital watermark inserter to embed again the watermark removed by said digital watermark remover in the dequantized signal without the digital watermark for performing local decoding; a second IDCT unit to inverse-discrete-cosine-transform the signal from said watermark inserter, to generate a second IDCT signal; a first adder to add the second IDCT signal from said second IDCT unit and motion compensation data, to generate a first added signal; a second buffer to temporarily save the first added signal and output the first added signal so that the first added signal is replayed; a multiplexer (MUX) to multiplex a first saved signal, a second saved signal, a

third signal having a predetermined value and a fourth signal to output a multiplexed signal, to generate a second added signal, the second added signal being the motion compensation data; a previous picture store block to temporarily save the second added signal and the second saved signal to generate the first saved signal; a future picture store block temporarily save the second added signal and to transmit the saved second added signal to said previous picture store block and said multiplexer as the second saved signal; and a multiplier by 1/2 means for multiplying by 0.5 the first and second saved signals, to generate the fourth signal.

Preferably, said digital watermark remover prevents an error of the temporal domain coding by the digital watermark.

Preferably, the digital watermark embedded by the watermark inserter I-picture-codes or P-picture-codes, and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to prevent the error of said temporal domain coding.

Said digital watermark remover is preferably arranged to correctly predict the motion information.

Preferably, the watermark, embedded by the watermark inserter within said moving picture encoder I-picture-codes or P-picture-codes, and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to predict correctly the motion information.

The decoder preferably receives the watermark from a recording medium.

The recording medium is preferably a disk.

The watermark is preferably embedded into a domain, such as a lead-in domain, which a user cannot access directly and the correct motion restoration is performed by reference to it when embedding and decoding said watermark.

Said decoder preferably has the function to decrease encoding efficiency by embedded digital watermark information.

Said decoder for carrying out said function preferably decreases an error while predicting motion of P and B pictures by embedded digital watermark information.

Said decoder preferably has the function of preventing degradation of image quality by embedded digital watermark information.

Said decoder for carrying out said function preferably decreases an error while predicting motion of P and B pictures by embedded digital watermark information.

According to a third aspect of the invention, there is provided an MPEG2 moving picture encoding/decoding system which processes a video input signal of MPEG2 moving picture data, the system comprising: an MPEG2 moving picture encoder, encoding a video input signal, said encoder comprising copy protection means for embedding a watermark into the encoded video signal, to generate an encoded bit stream; and an MPEG2 moving picture decoder, to decode the encoded bit stream from said moving picture encoder, said decoder comprising means

for replaying perfectly the MPEG2 moving picture data of the decoded bit stream into which the watermark is embedded.

Said copy protection means preferably comprises: a Discrete Cosine Transform (DCT) unit to discrete cosine transform the video input signal and the watermark; a digital watermark inserter to embed the watermark discrete-cosine-transformed by said DCT unit on a frequency domain of the discrete cosine transformed video input signal; a digital watermark remover for removing digital watermark information on the spatial domain of the DCT embedded for preventing an error while predicting motion for a P and B picture, the remover being installed between dequantizer the IDCT on the temporal domain.

Said digital watermark inserter is preferably located between said DCT and quantizer.

Said digital watermark inserter is preferably located between said quantizer and said VLC & MUX.

Said digital watermark inserter preferably uses 8×8 DCT to insert said watermark on the frequency domain.

Said IDCT preferably prevents an error of temporary domain coding by watermark.

Said means of replaying perfectly the MPEG2 moving picture data of the decoded bitstream, in which the watermark is embedded, preferably comprises the digital watermark remover, to prevent an error of temporal domain coding by said watermark.

Preferably, the watermark embedded by the digital watermark inserter within said moving picture encoder I-

picture-codes or P-picture-codes and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to prevent the error of said temporal domain coding.

Preferably, said digital watermark remover correctly predicts the motion information.

Preferably, the watermark embedded by the watermark inserter within said moving picture encoder I-picture-codes or P-picture-codes and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to predict exactly said motion information

The MPEG2 moving picture decoder preferably receives the watermark from a recording medium.

Said recording medium is preferably a disk.

Said watermark is preferably embedded into a domain, such as a lead-in domain, where a user cannot access directly and the correct motion restoration is performed by reference to it when embedding and decoding said watermark.

Said decoder may decrease encoding efficiency by embedded digital watermark information.

Said decoder for carrying out said function preferably decreases an error while predicting motion of a P and B pictures by embedded digital watermark information.

Said decoder preferably prevents degradation of image quality by embedded digital watermark information.

Preferably, said decoder for carrying out said function decreases the error while predicting motion of the P and B pictures by embedded digital watermark information.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 shows a conventional MPEG2 moving picture encoder;

Figure 2 shows a conventional MPEG2 moving picture decoder;

Figure 3 shows a structure of the video picture used in a conventional MPEG2 moving picture encoder/decoder;

Figure 4 shows three types of pictures and their relationship under the MPEG2 standard, i.e., I pictures, P predicted pictures, and B bidirectionally predicted pictures;

Figure 5 shows a sequence wherein discrete cosine transform coefficients are calculated and mixed and the discrete cosine transform coefficients are quantized in a zigzag manner;

Figure 6 shows a block diagram of an MPEG2 moving picture encoder according to an embodiment of the present invention; and

Figure 7 shows a block diagram of an MPEG2 moving picture decoder according the embodiment of the present invention.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the appended claims.

Figure 6 illustrates a block diagram of an MPEG2 moving picture encoder 200 according to an embodiment of a first aspect of the present invention and Figure 7 illustrates a block diagram of an MPEG2 moving picture decoder 245 according to an embodiment of a second aspect of the present invention.

In Figure 6, the MPEG2 moving picture encoder includes a frame memory 210, a frame/field memory 212, a subtractor 234, a DCT unit 214, a digital watermark inserter 240, a quantizer 216, an activity calculator 218, a rate controller 220, a dequantizer 222, a digital watermark remover 242, an IDCT unit 224, an adder 226, a frame memory 228, an adaption estimator 230, a motion estimator 232, a VLC & MUX 236, and a buffer 238. The frame memory 210, frame/field memory 212, subtractor 234, DCT unit 214, quantizer 216, activity calculator 218, rate controller 220, dequantizer 222, IDCT unit 224, adder 226, frame memory 228, adaption estimator 230, motion estimator 232, VLC & MUX 236 and buffer 238 operate in the same fashion as the frame memory 110, frame/field memory 112,

DCT 114, quantizer 116, activity calculator 118, rate controller 120, dequantizer 122, IDCT 124, adder 126, frame memory 128, adaption estimator 130, motion estimator 132, VLC & MUX 136 and buffer 138, respectively, shown in Figure 1 and previously described.

The digital watermark inserter 240 makes digital watermark information not removable by a user except an author and is embedded on a frequency domain 8×8 discrete-cosine-transformed of the encoded video signal, in order to reduce the burden on hardware. That is, the process of the digital watermark insertion by the digital watermark inserter 240 embeds the watermark information on the frequency domain, so that a duplicator cannot edit or remove a digital product illegally and arbitrarily.

Referring to Figure 6, the digital watermark inserter 240 is located between the DCT unit 214 and a VLC and a MUX 236 and is also located between the DCT unit 214 and the quantizer 216. It is preferable that the digital watermark inserter 240 is located immediately between the DCT 214 and the quantizer 216 for reasons of visual effect.

Because basically the MPEG2 standard embodies a frequency domain processing on the discrete cosine transform, the DCT unit 214 of Figure 6 discrete-cosine-transforms the digital watermark information, and then the digital watermark inserter 240 embeds it. The watermark information is embedded and processed in the digital watermark inserter 240 and then is added to an original image.

Thus, the watermark information embedded on the frequency domain is quantized in the quantizer 216 and is

variable-length-coded in the VLC & MUX 236. This is I picture coding process.

The dequantizer 222 dequantizes the I or P-picture coded data in which the watermark information is embedded and a digital watermark remover gets rid of the embedded watermark information. An IDCT unit 224 reverse-discrete-cosine-transforms the I or P-picture coded data for estimating correctly the motion information. Therefore, the MPEG2 moving picture encoder 200 prevents an error of a temporal domain coding by the watermark information. The MPEG2 moving picture encoder 200 compensates for the error by estimating an image motion that is being input at present from the I or P picture restored like this, and then codes a difference signal.

In this instance, the watermark information is embedded on the spatial domain in the back of said DCT. The digital watermark inserter 240 embeds the digital watermark information only on the spatial domain of the discrete cosine transform.

The digital watermark remover removes the digital watermark information on the spatial domain of the discrete cosine transform which was embedded for preventing the error during the motion estimation on the temporal domain for P and B pictures by using the embedded digital watermark information.

Figure 7 illustrates the MPEG2 moving picture decoder 245 to correctly decode an MPEG2 video stream including the digital watermark information embedded as in the MPEG2 moving picture encoder 200 shown in Figure 6.

The MPEG2 moving picture decoder includes a first buffer 250, a VLD & DEMUX 252, a dequantizer 254, a digital watermark remover 270, a first DCT 256, an adder 260, a previous picture store block 262, future picture store block 264, an adder 266, a multiplier by 1/2 268, operate in the same function as the first buffer 150, VLD & DEMUX 152, dequantizer 154, IDCT 156, adder 160, previous picture store block 162, future picture store block 164, adder 166, and a multiplier by 1/2 168, respectively, shown in Figure 2 and described above. The digital watermark remover 220 removes the watermark information embedded on the spatial domain of the discrete cosine transform while restoring motion of the P and B pictures.

The MPEG2 moving picture decoder 245 performs operations in the reverse order of the MPEG2 moving picture encoder 220.

Accordingly in the MPEG2 moving picture decoder 245, the watermark information embedded in the encoder has to be transmitted.

In the case that an encoded MPEG video stream is transmitted through a storage medium such as a disk, it is possible to perfectly restore motion, referring to it while decoding by embedding the watermark on a lead-in domain which the user cannot access directly.

The digital watermark apparatus according to embodiments of the present invention for preventing the illegal copy of MPEG2 moving picture data makes it possible to prevent degradation of the image quality and efficiency reduction of encoding by the embedded digital watermark information by decreasing the error while

estimating motion of the P and B pictures by using the embedded digital watermark information.

In the case of decoding locally for compensating motion, once the embedded watermark information is removed while encoding the I or P picture, and it is decoded locally, and then it is used as data for motion compensation while decoding the P and B pictures.

And in case of decoding for the decoding output, the MPEG2 moving picture decoder 221 again embeds the watermark information that had been removed once for decoding locally, and reverse-discrete-cosine-transforms the embedded watermark information, and then adds motion compensation data thereto.

Conclusively the image in which the watermark information is embedded is replayed perfectly. Further, there is an effect of decreasing degradation of the image quality to a maximum extent by restraining an increase of encoding information according to the organization of the invention as noted above, and that the watermark information is not removed easily by a user, except an author.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or

process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. An MPEG2 moving picture encoder to encode a video signal with digital watermark information and including a frame memory, a frame/field memory, an activity calculator, a rate controller, a Discrete Cosine Transform (DCT) unit, a quantizer, a dequantizer, an Inverse Discrete Cosine Transform (IDCT) unit, an adaptation estimator, a motion estimator, a variable length coder and multiplexer (VLC & a MUX) and a buffer, the MPEG2 moving picture encoder comprising:

a Discrete Cosine Transform (DCT) unit to discrete-cosine-transform the digital watermark information;

a digital watermark inserter installed between said DCT and said VLC & MUX, to embed the digital watermark information discrete-cosine-transformed by said DCT on a frequency domain of the video signal; and

a digital watermark remover, installed between said dequantizer and said IDCT, to remove digital watermark information on a spatial domain of the DCT embedded, so as to prevent an error during estimating motion on a temporal domain for P and B pictures of the video signal.

2. The MPEG2 moving picture encoder as set forth in claim 1, wherein said digital watermark inserter is located between said DCT and quantizer.

3. The MPEG2 moving picture encoder as set forth in claim 1, wherein said digital watermark inserter is located between said quantizer and said VLC & MUX.

4. The MPEG2 moving picture encoder as set forth in any of claims 1 to 3, wherein said DCT unit uses an 8x8 DCT to

embed the watermark information on the frequency domain of the video signal.

5. The MPEG2 moving picture encoder as set forth in any of claims 1 to 4, wherein said IDCT prevents an error of a temporary domain coding by watermark.

6. An MPEG2 moving picture decoder to decode an encoded bit stream comprising:

a first buffer to receive and save the encoded bit stream;

a variable length decoder and demultiplexer (VLD & a DEMUX) to receive the encoded bit stream from said first buffer and to variable-length-decode the encoded bit stream;

a dequantizer to dequantize the variable length decoded signal from said VLD & DEMUX;

a digital watermark remover to remove a digital watermark embedded in the dequantized signal to locally decode by reading watermark information and information from said dequantizer, to generate a dequantized signal without the digital watermark;

a first Inverse Discrete Cosine Transform (IDCT) unit to inverse-discrete-cosine-transform the dequantized signal without the digital watermark from said watermark remover, to generate a first IDCT signal;

a digital watermark inserter to embed again the watermark removed by said digital watermark remover in the

dequantized signal without the digital watermark for performing local decoding;

a second IDCT unit to inverse-discrete-cosine-transform the signal from said watermark inserter, to generate a second IDCT signal;

a first adder to add the second IDCT signal from said second IDCT unit and motion compensation data, to generate a first added signal;

a second buffer to temporarily save the first added signal and output the first added signal so that the first added signal is replayed;

a multiplexer (MUX) to multiplex a first saved signal, a second saved signal, a third signal having a predetermined value and a fourth signal to output a multiplexed signal, to generate a second added signal, the second added signal being the motion compensation data;

a previous picture store block to temporarily save the second added signal and the second saved signal to generate the first saved signal;

a future picture store block temporarily save the second added signal and to transmit the saved second added signal to said previous picture store block and said multiplexer as the second saved signal; and

a multiply by 1/2 means for multiplying by 0.5 the first and second saved signals, to generate the fourth signal.

7. The MPEG2 moving picture decoder as set forth in claim 6, wherein said digital watermark remover prevents an error of the temporal domain coding by the digital watermark.

8. The MPEG2 moving picture decoder as set forth in claim 6 or 7, wherein the digital watermark embedded by the watermark inserter I-picture-codes or P-picture-codes, and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to prevent the error of said temporal domain coding.

9. The MPEG2 moving picture decoder as set forth in claim 6, 7 or 8, wherein said digital watermark remover correctly predicts the motion information.

10. The MPEG2 moving picture decoder as set forth in claim 8, wherein the watermark, embedded by the watermark inserter within said moving picture encoder I-picture-codes or P-picture-codes, and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to predict correctly the motion information.

11. The MPEG2 moving picture decoder as set forth in claim 6, wherein the decoder receives the watermark from a recording medium.

12. The MPEG2 moving picture decoder as set forth in claim 11, wherein the recording medium is a disk.

13. An MPEG2 moving picture decoder as set forth in claims 11, wherein the watermark is embedded into a domain which a user cannot access directly and the correct motion restoration is performed by reference to it when embedding and decoding said watermark.

14. The MPEG2 moving picture decoder as set forth in claim 13, wherein the domain, which a user cannot access directly, is a lead-in domain.

15. The MPEG2 moving picture decoder as set forth in any of claims 6 to 14, wherein said decoder has the function to decrease encoding efficiency by embedded digital watermark information.

16. The MPEG2 moving picture decoder as set forth in claim 15, wherein said decoder for carrying out said function decreases an error while predicting motion of P and B pictures by embedded digital watermark information.

17. The MPEG2 moving picture decoder as set forth in claim 6, wherein said decoder has the function of preventing degradation of image quality by embedded digital watermark information.

18. The MPEG2 moving picture decoder as set forth in claim 17, wherein said decoder for carrying out said function decreases an error while predicting motion of P and B pictures by embedded digital watermark information.

19. An MPEG2 moving picture encoding/decoding system which processes a video input signal of MPEG2 moving picture data, the system comprising:

an MPEG2 moving picture encoder, encoding a video input signal, said encoder comprising copy protection means for embedding a watermark into the encoded video signal, to generate an encoded bit stream; and

an MPEG2 moving picture decoder, to decode the encoded bit stream from said moving picture encoder, said decoder comprising means for replaying perfectly the MPEG2 moving picture data of the decoded bit stream into which the watermark is embedded.

20. The MPEG2 moving picture encoding/decoding system as set forth in claim 19, wherein said copy protection means comprises:

a Discrete Cosine Transform (DCT) unit to discrete cosine transform the video input signal and the watermark;

a digital watermark inserter to embed the watermark discrete-cosine-transformed by said DCT unit on a frequency domain of the discrete cosine transformed video input signal;

a digital watermark remover for removing digital watermark information on the spatial domain of the DCT embedded for preventing an error while predicting motion for a P and B picture, the remover being installed between dequantizer the IDCT on the temporal domain.

21. The MPEG2 moving picture encoding/decoding system as set forth in claim 20, wherein said digital watermark inserter is located between said DCT and quantizer.

22. The MPEG2 moving picture encoding/decoding system as set forth in claim 20, wherein said digital watermark inserter is located between said quantizer and said VLC & MUX.

23. The MPEG2 moving picture encoding/decoding system as set forth in claim 21, wherein said digital watermark

inserter uses 8×8 DCT to insert said watermark on the frequency domain.

24. An MPEG2 moving picture encoder ing/decoding system as set forth in claim 20, wherein said IDCT prevents an error of temporary domain coding by watermark.

25. The MPEG2 moving picture encoding/decoding system as set forth in claim 19, wherein said means of replaying perfectly the MPEG2 moving picture data of the decoded bitstream, in which the watermark is embedded, comprises the digital watermark remover, to prevent an error of temporal domain coding by said watermark.

26. The MPEG2 moving picture encoding/decoding system as set forth in claim 25, wherein the watermark embedded by the digital watermark inserter within said moving picture encoder I-picture-codes or P-picture-codes and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to prevent the error of said temporal domain coding.

27. The MPEG2 moving picture encoding/decoding system as set forth in claim 26, wherein said digital watermark remover correctly predicts the motion information.

28. The MPEG2 moving picture encoding/decoding system as set forth in claim 27, wherein watermark embedded by the I-watermark inserter within said moving picture encoder I-picture-codes or P-picture-codes and said dequantizer dequantizes it, and then said digital watermark remover removes it, in order to predict exactly said motion information

29. The MPEG2 moving picture encoding/decoding system as set forth in claim 28, wherein the MPEG2 moving picture decoder receives the watermark from a recording medium.

30. The MPEG2 moving picture encoding/decoding system as set forth in claim 29, wherein said recording medium is a disk.

31. The MPEG2 moving picture encoding/decoding system as set forth in claim 29, wherein said watermark is embedded into a domain where a user cannot access directly and the correct motion restoration is performed by reference to it when embedding and decoding said watermark.

32. The MPEG2 moving picture encoding/decoding system as set forth in claim 31, wherein the domain, which the user can not access directly, is a lead-in domain.

33. The MPEG2 moving picture encoding/decoding system as set forth in claim 32, wherein said decoder decreases encoding efficiency by embedded digital watermark information.

34. The MPEG2 moving picture encoding/decoding system as set forth in claim 33, wherein said decoder for carrying out said function decreases an error while predicting motion of a P and B pictures by embedded digital watermark information.

35. The MPEG2 moving picture encoding/decoding system as set forth in claim 19, wherein said decoder prevents degradation of image quality by embedded digital watermark information.

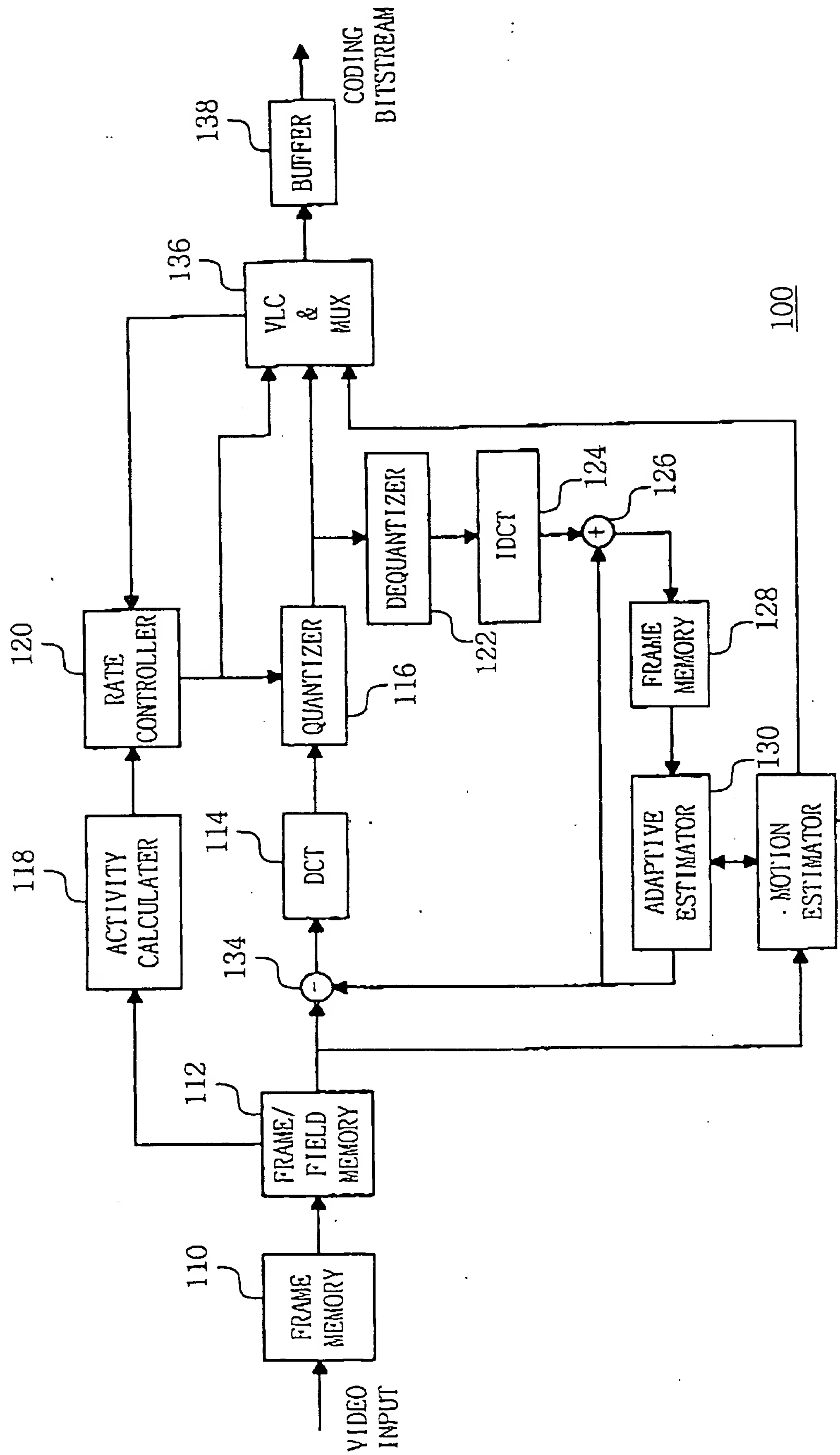


FIG. 1 PRIOR ART

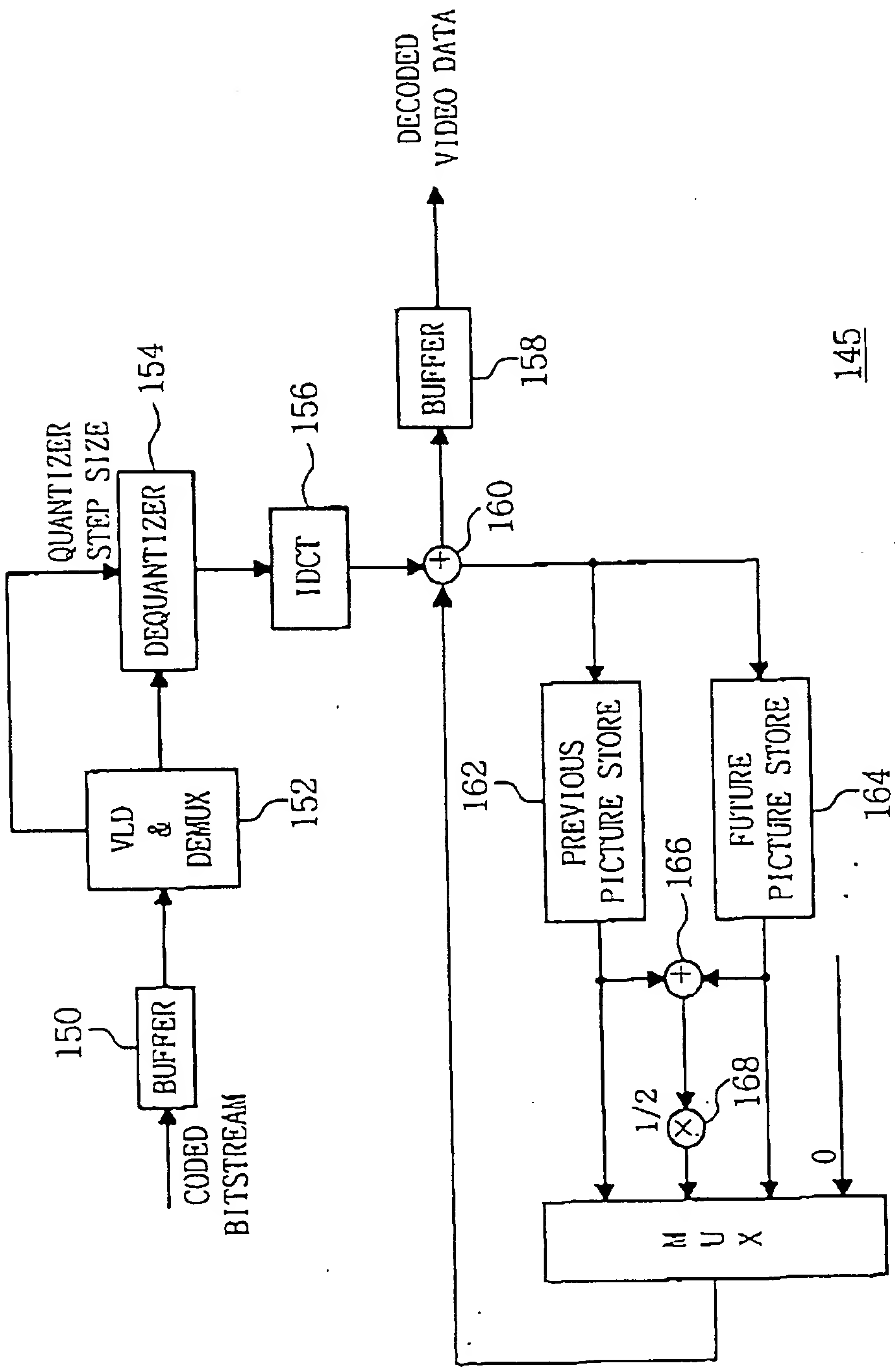


FIG. 2 PRIOR ART

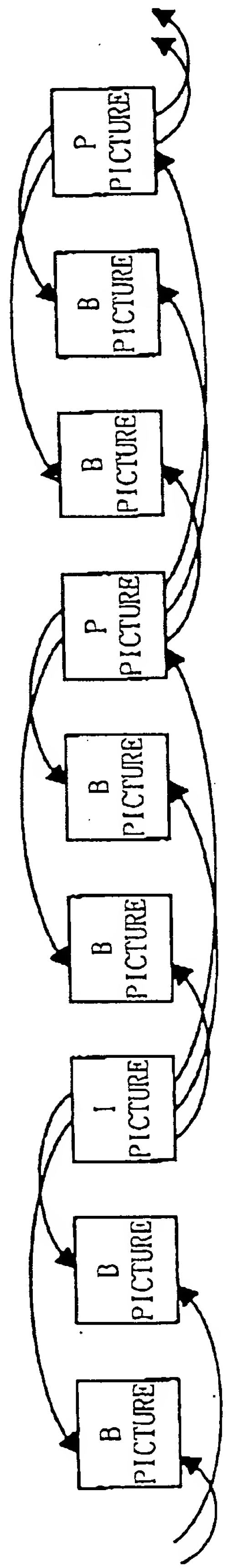


FIG. 3 PRIOR ART

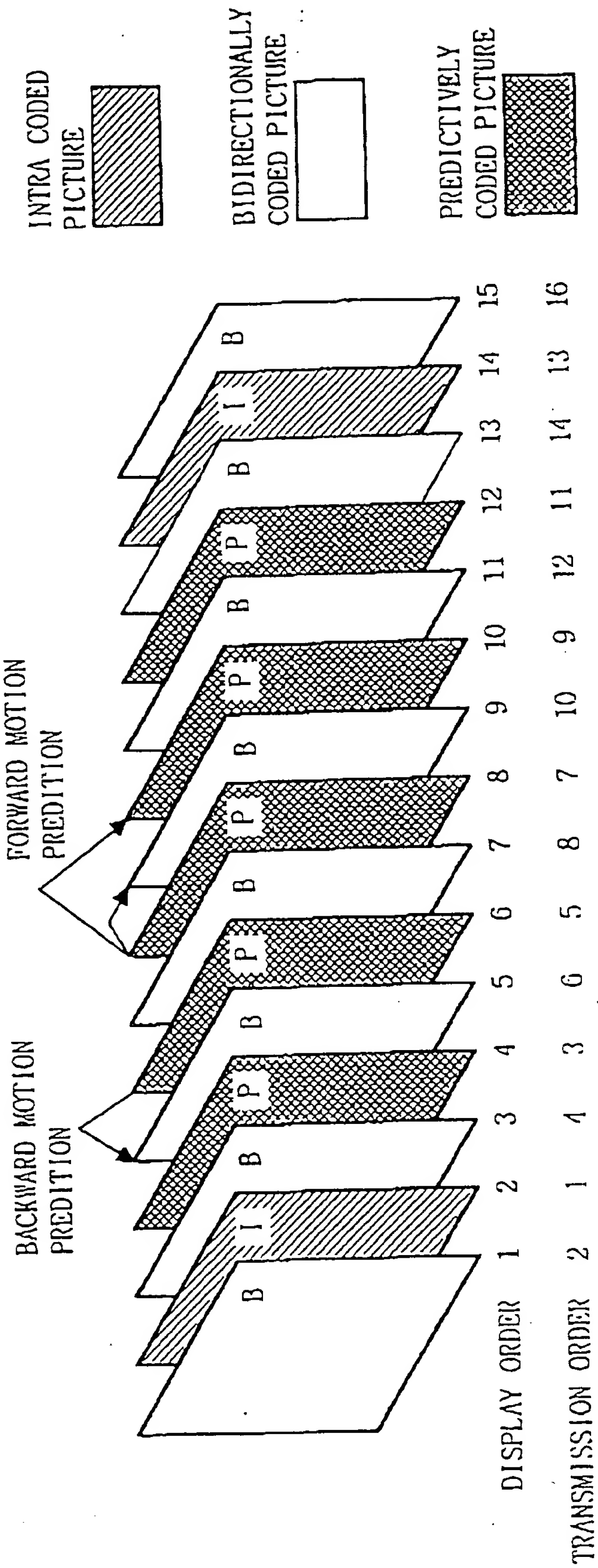
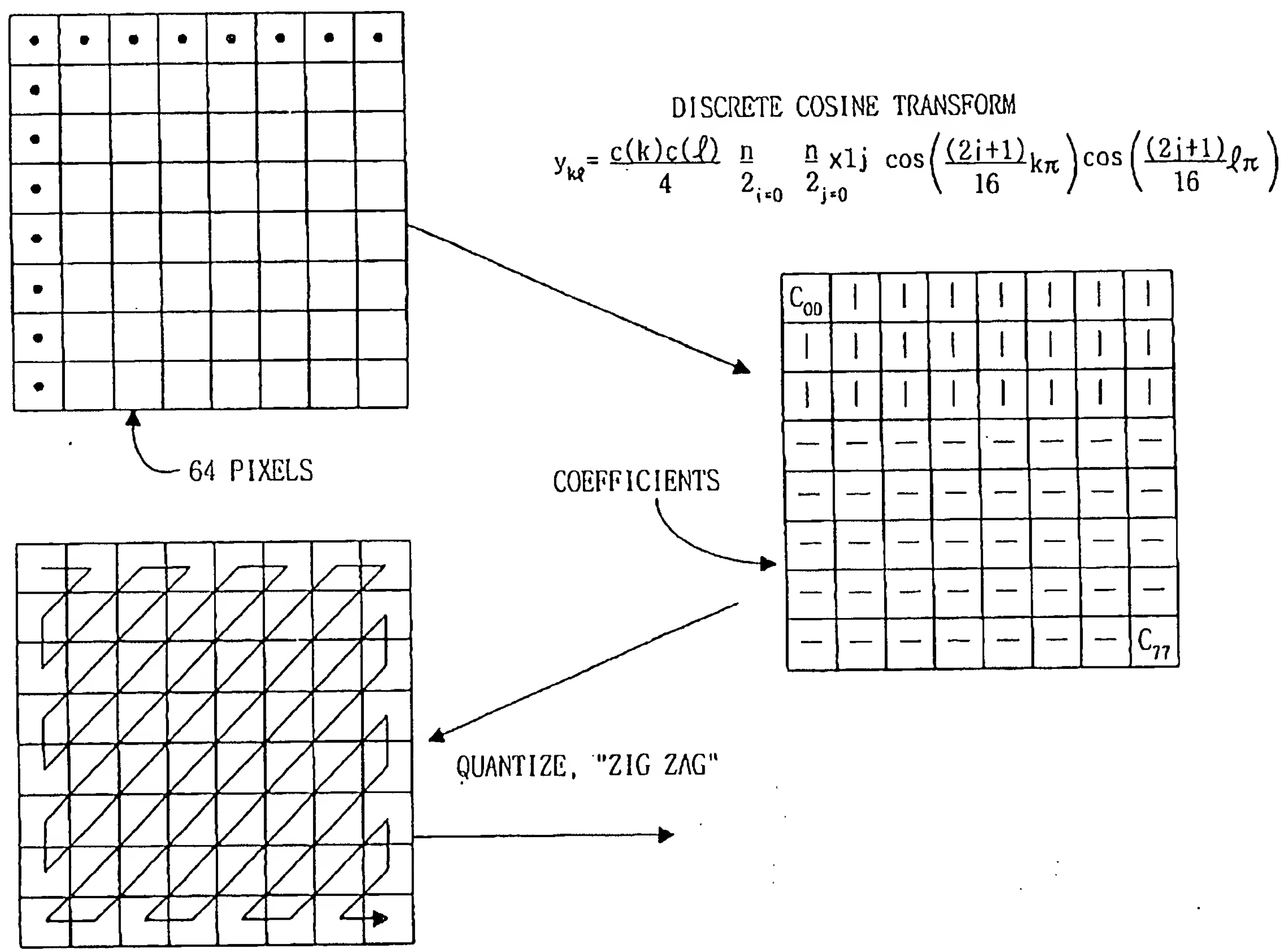
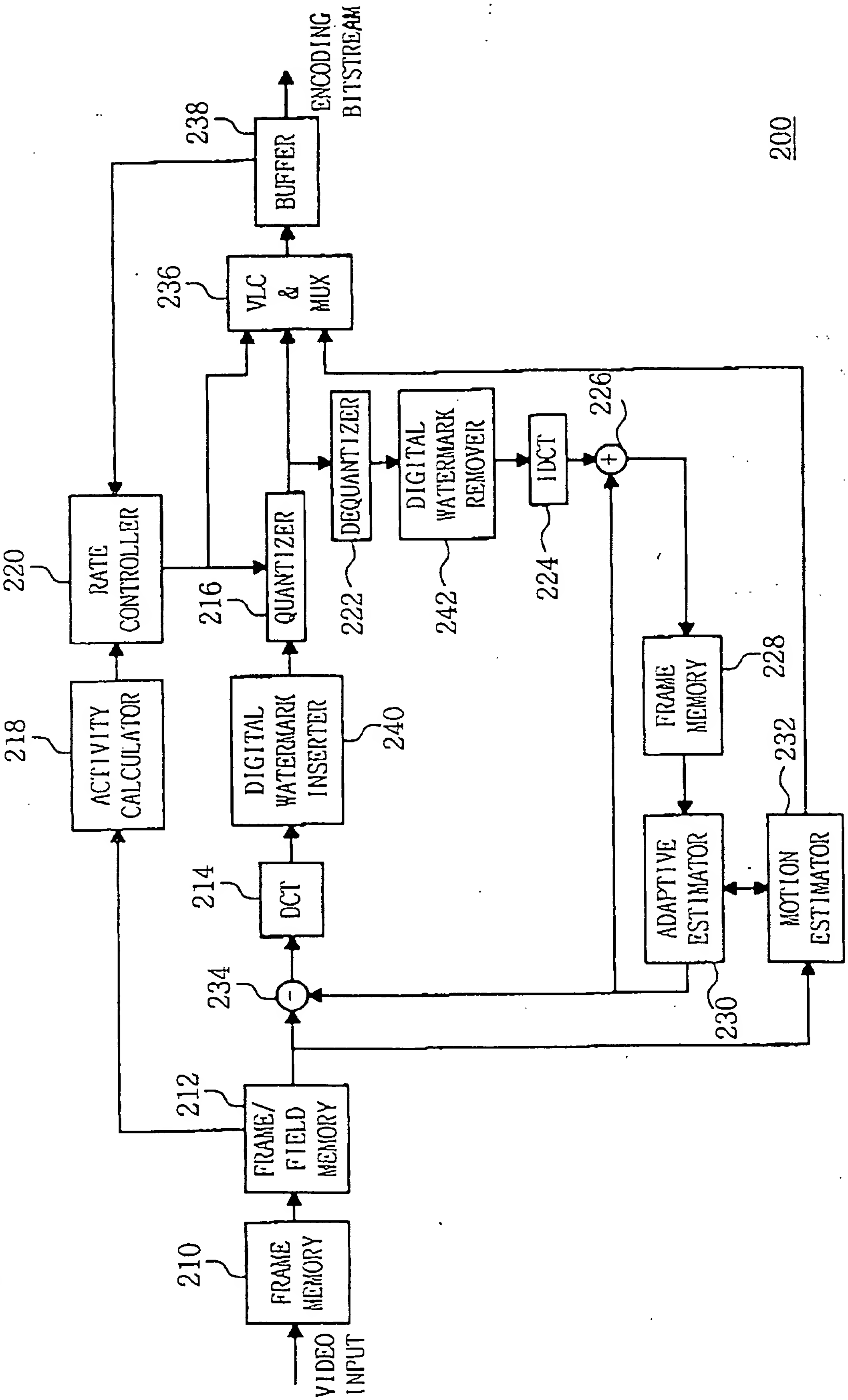


FIG. 4 PRIOR ART

FIG. 5 PRIOR ART

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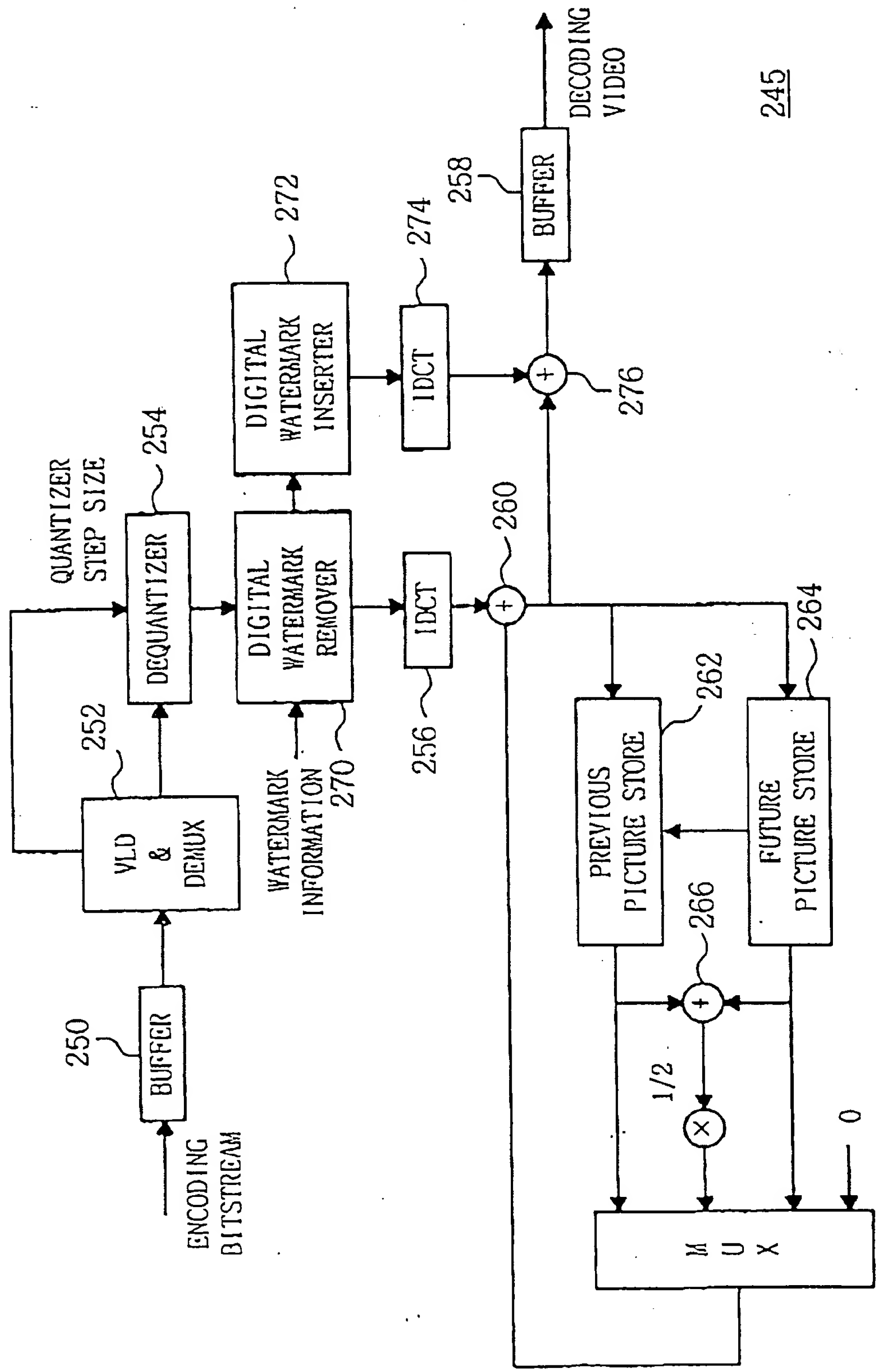
BUFFER
236
VLC & MUX
220
RATE CONTROLLER
216
QUANTIZER
DEQUANTIZER
222
DIGITAL WATERMARK REMOVER
242
IDCT
224
226
218
ACTIVITY CALCULATOR
DIGITAL WATERMARK INSERTER
240
FRAME MEMORY
228
214
DCT
ADAPTIVE ESTIMATOR
230
MOTION ESTIMATOR
232
234
212
FRAME/ FIELD MEMORY
210
FRAME MEMORY
VIDEO INPUT
200

FIG. 6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VLD & DEMUX
252
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DEQUANTIZER
254
DIGITAL WATERMARK REMOVER
270
WATERMARK INFORMATION
DIGITAL WATERMARK INSERTER
272
IDCT
274
IDCT
256
260
276
BUFFER
258
DECODING VIDEO
245
PREVIOUS PICTURE STORE
262
FUTURE PICTURE STORE
264
266
1/2
0
MUX

FIG. 7